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(54) Improvements in pipe joints

(57) A method of forming angled joints between metal tubes or pipes comprises inserting the end of a tube 1 through a flow-drilled bushed hole 5 in a larger tube 2, placing a split ring of solder 4 around the inserted tube to lie in the funnel shaped entry of the external bush and applying heat from means 6 within the holed tube to melt the solder which penetrates between the inserted tube wall and the bush to seal the joint. This method is more reliable, quicker, and requires less skill on the part of the operator than known methods of welding together metal tubes or pipes by applying heat externally.

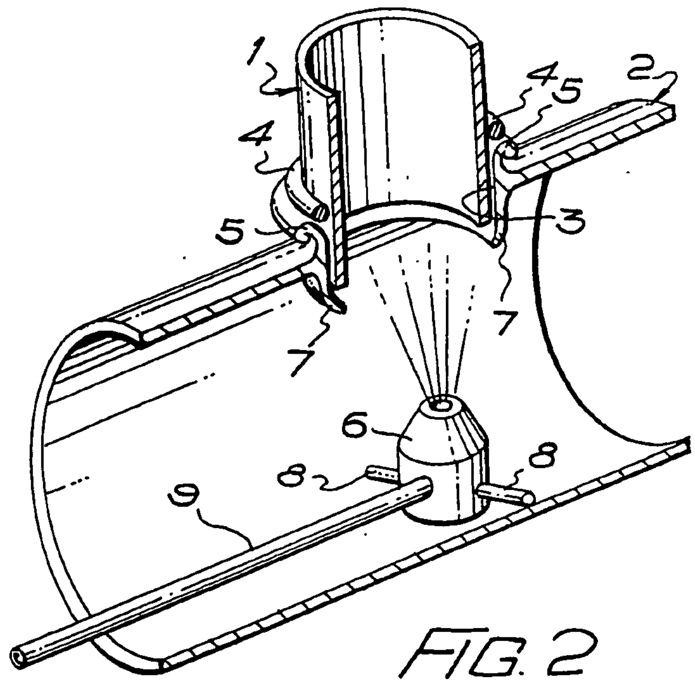

FIG. 2

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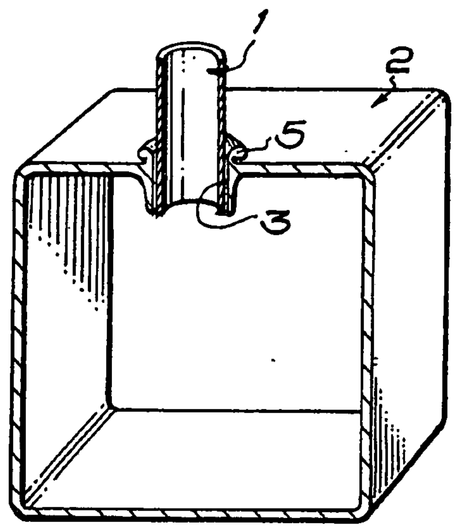

FIG. 1

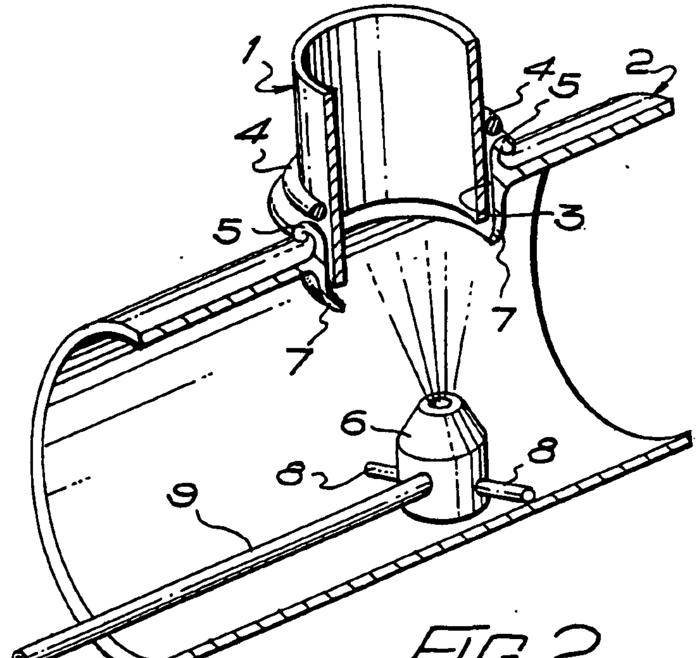

FIG. 2

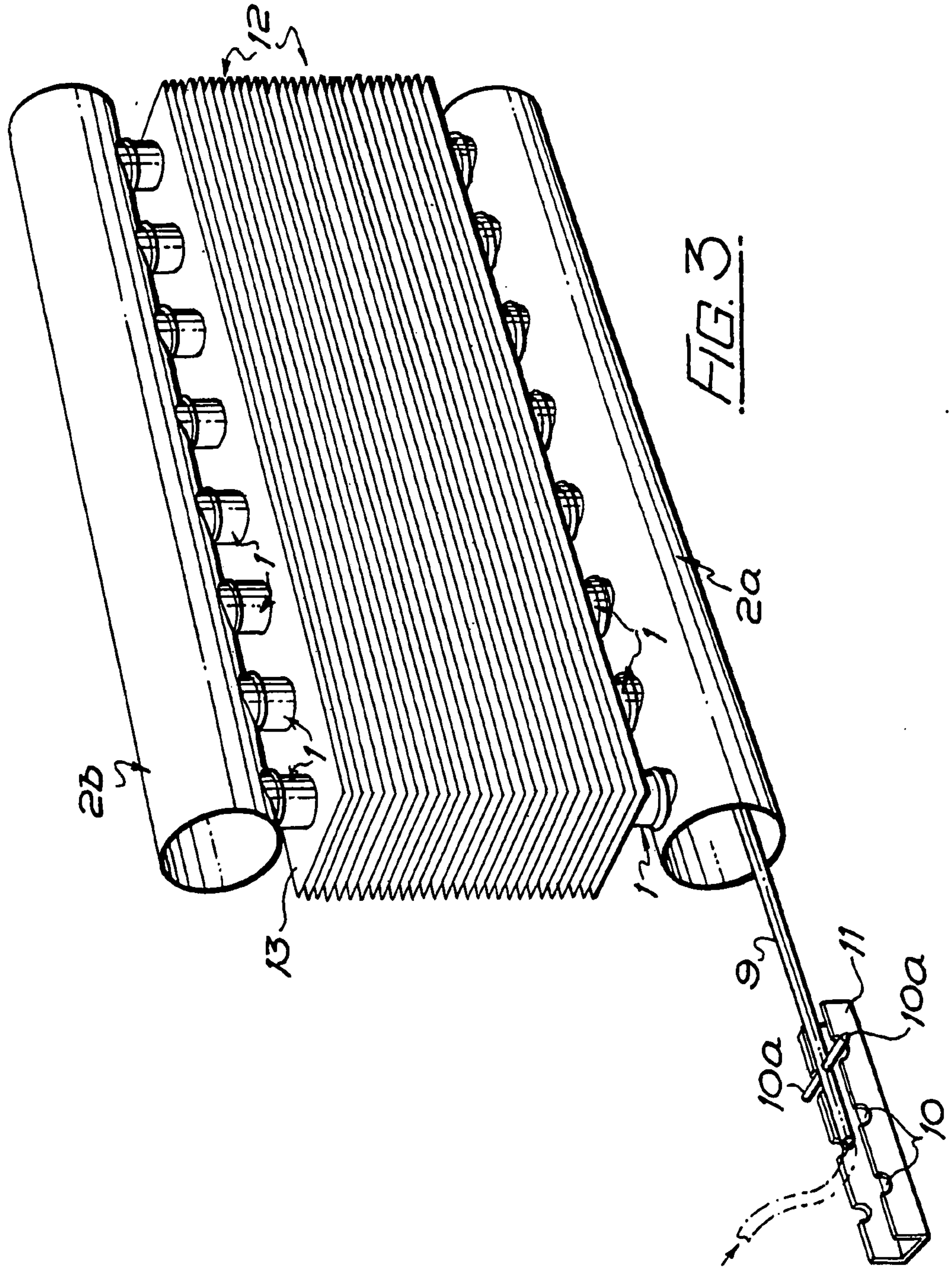

FIG. 3

SPECIFICATION
Impr vements in pipe j ints

The invention relates to an improved method of forming angled joints between metal tubes or pipes and tubes or pipes joined by the method.

It has been proposed to form an angled joint between metal tubes by drilling a substantially circular hole of appropriate diameter through the wall of one tube and inserting the end of the other smaller diameter tube to protrude a short distance into the bore of the first mentioned tube. A stick of solder is then run around the inserted tube to lie on the external surface of the holed tube; heat is applied externally to the tubes by a blow torch or other suitable means to melt the solder which then penetrates between the inserted tube wall and the edge of the hole to seal the joint.

This method of joining metal tubes has the disadvantage that the shape of a plain drilled hole is only approximately circular so that in certain places there are larger gaps between the inserted tube wall and the edge of the hole and large amounts of solder must be used in attempting to ensure that the gap is sealed. Furthermore, the joint formed is weak because of the small area of pipe over which sealing occurs.

It has been further proposed to form an angled joint between metal tubes in a manner similar to that described but with a bushed hole as formed by a flowdrill. As a flowdrilled hole may be formed more accurately circular than a plain hole there are no large or irregular gaps and a saving may be made in the amount of solder used. When the joint area is heated externally and solder is applied, it melts and penetrates some distance between the inserted tube wall and the flowdrill bush to form a stronger joint than by the aforementioned method as sealing occurs between larger areas of pipe surface. Although this method is an improvement in that it allows for the use of smaller quantitites of solder and the formation of a stronger joint, it requires equal skill and time taken on the part of the operator and more over is still unreliable in that solder penetration is not assured through the whole of the length of the bush because the heat is unevenly applied, usually by a blow torch, and molten solder (due to surface tension effects) tends to move towards the hottest region at the tube surface rather than penetrate the whole length of the bush.

The object of the present invention is to provide a method of forming angled joints between metal tubes or pipes which is more reliable, quicker and requiring less skill on the part of the operator than the known methods.

According to the present invention a method of forming angled joints b tween metal tubes or pipes comprises forming a bushed hole in one tube by means of a flowdrill, inserting an end of th other or smaller tube therethrough, placing a ring of solder or brazing metal around the inserted tube on the external surface of the bush in the holed tube and applying heat from within the holed tube to melt the solder which penetrates between the inserted tube wall and the bush to seal the joints throughout the length of the bush.

The invention will be described with reference to the accompanying drawings:—

Fig. 1 is a vertical section showing a flowdrilled hole in a rectangular tube with a smaller tube sealed therein.

Fig. 2 is a vertical section showing a flowdrilled hole in a cylindrical tube with a smaller tube inserted therein for sealing by a solder ring heated internally of the tube.

Fig. 3 is a perspective view of a heat exchanger in which smaller tubes are inserted tinto flowdrilled holes in the header or manifold tubes.

In joining a metal tube 1 of say 6 mm diameter to a metal tube 2 of 22 mm diameter (Fig. 2) a circular bushed hole 3 of a diameter slightly larger than 6 mm is formed by means of a flowdrill in the wall of the 22 mm diameter tube 2. The end of the 6 mm tube 1 is inserted therethrough until level with the internal end of the bush formed in the tube 2 and a close fitting silver solder split ring 4 is placed around the inserted tube 1 to lie in the funnel shaped entry of the external part of the bush 5. A heating device (such as a welding torch 6) in inserted into the tube 2 positioned beneath the inserted end of the tube 1 for a few seconds. The metal of the bush 5 and inserted tube 1 are heated from inside the tube 2 and conduct heat to the solder ring 4 which melts and penetrates between the wall of the inserted tube 1 and the whole length of the bush 5 to seal the joint.

The molten solder readily penetrates the narrow gap by capillary attraction and also because of its tendency to move towards the hottest regions of metal which at this time is the end of the internal bush 5 and inserted tube 1. Penetration by molten solder is therefore assured when heat is applied internally of the larger diameter holed tube 2.

The tubes being joined may be of any suitable diameter, although the holed tube must have a larger diameter than the inserted tube to accommodate the flowdrill bush 5.

The joining of a plurality of smaller diameter tubes to a larger diameter tube may be effected by inserting the smaller diameter tubes into flowdrilled holes of an appropriate size in the larger diameter tube, positioning solder rings as described, and applying heat from inside the large diameter tube to the base of each inserted tube in turn so that the solder melts and seals each joint in turn. The holes drilled in the larger tube may be arranged in a straight or staggered row, such as in a heat exchanger, and the cross section of the larger tube may be circular, or otherwise as required. The angle at which the holes are drilled and the tubes inserted need not be 90°. The solder may be any suitable hard or soft solder or brazing metal.

As mentioned in an earlier specification No 81/01835 when forming a flowdrilled hole the length of the portion of the bush 5 extending into

a tube 2 may be shortened by flowdrilling into a hole in the tube wall having a bore smaller than the internal diameter of the finished bush. This hol may be predrilled by a separate conventional drilling operation or by using a self-predrilling flowdrill. The internal length of the bush 5 depends on the diameter of the initial bore, a larger diameter initial bore giving a shorter internal bush and a smaller diameter initial bore giving a longer internal bush, and the diameter of bore can be calculated to give any desired length of internal bush. As mentioned in specification No. 81/01835 the flowdrill hole may have an internal step 7.

The advantage of the present method of forming angled joints between metal tubes over the previously known methods are firstly the extreme reliability of the sealing of the joints as the molten solder readily penetrates between the inserted tube wall and the whole length of the bush, secondly increasing the speed of the whole operation, thirdly that little skill is needed by the operator compared to that required for soldering by the known methods so that the present method is amenable to automation, and finally that access to each joint is facilitated by passing a heat source internally in the holed pipe compared to manoeuvring a blow torch to direct heat externally to the joint especially when the inserted tubes are provided with fins 12 as in many types of heat exchangers 12, and there is less risk of overheating and damaging adjacent metal.

Apparatus for sealing the end of smaller tubes 1 into the bush or bushes is shown in Fig. 2 and comprises a blow torch 6 provided with legs 8 to position the torch in the larger tube 2 mounted on a rod 9 engaging a grooved or notched bar 11 with the grooves or notches 10 spaced apart to agree with the spacing of the tubes 1 in the header tube or manifold 2*a* of a heat exchanger 12. The torch on the rod 9 is inserted into the tube 2 to seal the joint with the tube 1 remote from the entry end of the torch, as each tube is sealed the rod is withdrawn one groove or notch to seal an adjacent tube.

The rod 9 is provided with a transverse strip or rod 10*a* arranged at right angles to the torch 6 to engage each groove or notch 11 in turn so that at each operation the torch is correctly positioned. The tubes may be similarly secured in the heater 2*b* by inverting the heat exchanger. The depth step or flange 7 may be formed on the bush 5 to limit the insertion of the tube 1.

CLAIMS

1. A m thod f forming angled joints between metal tubes or pip s comprising forming a bushed hole in one tube by means of a flowdrill, inserting an end of the other smaller tube therethrough, placing a split ring of solder or brazing metal around the inserted tube on the external surface of the bush in the holed tube and applying heat from within the holed tube to melt the solder which penetrates between the inserted tube wall and the bush to seal the joint throughout the length of the bush.

2. A method of forming angled joints between metal tubes or pipes as in claim 1, in which the bush is formed with a flange or step at the lower end to position the smaller tube in the bush.

3. A method as in claim 1 for jointing tubes in a heat exchanger comprising a torch carried by a rod for insertion when in use into a manifold or header of the heat exchanger, means for positioning the rod in the manifold or header to bring the torch successively below each flowdrilled bush and the tube therein to melt the solder to seal the joint throughout the length of the bush.

4. Apparatus for carrying out the method of claim 1, comprising flowdrilling installation for forming a bushed hole in a tube, a ring of solder surrounding a joint between the bush and a tube inserted therein, a torch for insertion into the bushed tube to apply heat internally to seal the joint between the bush and the tube inserted therein.

5. Apparatus as in claim 4 for securing tubes in a heat exchanger in which the torch is supported on legs in the larger tube and positioned in the tube by a rod formed with a transverse strip engaging grooves or notches in turn in a horizontal bar to position the torch in the tube, the grooves or notches in the horizontal bar being spaced apart longitudinally to correspond with the spacing of the heat exchanger tubes.

6. A method for forming angled joints between two tubes substantially as hereinbefore described.

7. Apparatus for carrying out the method of claim 1 for jointing two angled tubes substantially as described with reference to the accompanying drawings.

8. Jointed tubes when formed by the method of claim 1.

9. A heat exchanger substantially as described with reference to Fig. 3 of the accompanying drawings.

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